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METHODS OF PRODUCING ENLARGEMENTS AND LANTERN SLIDES OF MICROSCOPIC OBJECTS FOR CLASS DEMONSTRATIONS

BY JOHN ASPINWALL

For convenience we will divide the subject of this paper into three parts:

1. Making the Photomicrograph.
2. Making the Lantern Slide.
3. Making the Enlargement.

MAKING THE PHOTOMICROGRAPH

The method used by the writer is the result of an attempt to produce photomicrographs of considerable magnification, and yet of great depth of focus, while using lenses of high resolving power.

In the ordinary process of photomicrography, the amplification is obtained in one of three ways:

1. A low power objective, and fairly high power ocular.
2. A high power objective and low power ocular, or none.
3. A great extension of the bellows of the camera, combined with the use of a projection eyepiece, or none.

In all of these cases, amplification is obtained at the expense of the focal depth; and, although there is often definition over an extended area at right angles to the axis of the beam of light, the relation of the parts is only shown over a very thin area in the line of the axis of the instrument.

The method of the writer is to use an objective of medium power, where fairly high amplification is desired, say a one-quarter Spencer, making the negative of a diameter of 1½ to 2 inches.

In a lantern slide camera, enlarge from one-half to three-quarters of the central area of its negative to twice its diameter upon a Paget lantern slide plate. By another enlargement from this positive, a negative of any diameter can be secured.

This appears a roundabout method, but the object is obtained, viz., to get the maximum depth of focus and any desired amplification.

It is important to make the positive upon a plate rich in chloride, such as the Paget, in order to obtain a deposit without grain, and capable of registering the minutest detail with no suggestion of film structure.

It is also important that the enlarging lens be of the very best type, such as a Ross, a Guerz, or a Zeiss, and well stopped down.

In making a negative for an enlargement on bromide paper, the same methods may be pursued.

The writer prefers, in making the original negative, to use an objective without the ocular, and instead of the usual substage condenser of high angle, to employ an ordinary objective of, say, one inch focus.

For the best results, the beam of light approaching this objective condenser should be of a very low angle. This can be obtained in the ordinary photomicrographic outfit by the interposition between the lantern condenser and substage of a biconcave lens of suitable curvature.

MAKING THE LANTERN SLIDE

First of all, no American plate known to the writer is capable of producing the best grade of lantern slide. We prefer the Paget plate, which is made in England.

It is important to depart from the beaten path, and leave, in most cases, the black and white effect, and reach into the warmer tones of brown, purple and red.

This may sound esthetic, but the fact remains that the subject is given a look of life and substance by adopting a warmer tone. Nothing but a suggestion of death lurks in the chalky white and black tone of the ordinary commercial lantern slide.

It is certain that two slides of a hand suffering from skin disease—one in black and white, and the other in a tone near to flesh tint—bear no comparison; one is the hand of the dead, the other that of some living being.

In the matting, too, there is much to do with the ultimate results. This point cannot be too strongly enforced. Any subject surrounded by a mass of glaring white light will fail to show the most delicate lines and gradations of tone, owing to the eye being dazzled by the surrounding whiteness.

The proper mat is one capable of being cut to suit the subject; such an one, for instance, as that known in the photographic world as the Boston mat. The lines given on this mat enable one to shape the opening to suit the subject. The use of the mat of ordinary size, such as usually employed by the commercial lantern slide maker, would seem to indicate that the value of the slide was in proportion to the area of the opening; while the reverse is really the case in most instances.

The Paget slow plate is capable of giving tones from black, through the browns and reds, into the purple.

The developer used by the writer is made up as follows:

Hydrochinon	100 grains
Sodium sulphite (crystals)	400 grains
Sodium carbonate (crystals)	400 grains
Water	20 ounces

The exposure will run from 20 seconds to 15 minutes, according to the light or the tone desired. A long exposure and a weak developer, with bromide added, producing the warmer tones, and a short exposure, with strong developer, the blacks and whites. The dilution of developer is made as follows:

1. For black tone—

Developer	1 ounce
Water	2 ounces
10% solution of bromide	1 to 2 drops

2. For brown tone—

Developer	1 ounce
Water	4 ounces
Bromide	5 to 8 drops

3. For red tone—

Developer	1 ounce
Water	8 ounces
Bromide	15 to 25 drops

4. For purple tone—

   Over exposure and the use of the No. 2 dilution.

As Hydrochinon is inert at low temperatures, for uniform results the developer should be slightly warm in winter, so that it will be between 70 and 80 degrees F.

The exposure is made, say 20 seconds for black tones, 1½ to 2 minutes for brown tones, and from 5 to 15 minutes for red ones. The quality of the negative counts, of course, and no rule can be given—the foregoing exposures being merely suggestive.

The reader will have to work out the problem from the hints herein given. The time of development increases as the tones get warmer.

The writer has obtained the best results in making slides by using a reducing and enlarging camera in preference to making slides by contact with the negative.

It must be apparent to anyone that a slide from a photomicrographic negative 2¼ inches in diameter will be superior in depth of focus and detail to one made by reducing a negative six inches in diameter made of the same subject and area of subject where this increased size of negative is obtained by drawing out the bellows, or using a higher power objective. Quite a remarkable effect can be obtained in some cases where tissues are differentiated by highly stained nuclei, in the following manner:

A lantern slide is made with the reddest tone obtainable. After fixing and washing, but before the slide is dry, it is toned for a short time in a gold bath made as follows:

1.	Sulphocyanide of ammonium	200 grains
	Water	32 ounces
	Carbonate of soda (granuls)	2 grains
2.	Chloride of gold (brown)	15 grains
	Water	1 ounce

For use take two ounces of No. 1 and four drops of No. 2, always remembering to add No. 2 to No. 1, and never reversing the operation. This amount of solution will tone one slide to a perfect blue throughout; but in our process, we only immerse the red slide, before spoken of, long enough to permit the gold to attack the lighter deposit of silver in the film. The result of this will be to give the lantern slide an appearance of a microscopic slide, which has a nuclear stain of carmine, and the deepest stain of methyl blue.

The gold bath should be kept at a temperature of from 72 to 76 degrees—a lower temperature would result in failure.

It would seem that the effect we obtain is not altogether permanent, as, after a couple of years or so, the blue appears to gradually creep into the red nuclei and spoil the differential effect.

You must not fail to remember that in all these colored effects, any shadow in the negative caused by refraction will assume solid proportions when interpreted in the color of the subject. This, however, holds true somewhat of a black deposit. I would advise using the more brilliant tones only upon subjects made with a low power objective, unless it be of a very thin section, and an image which it is clear cut and free from exterior refraction lines.

A finely hand colored slide is probably the most perfect for the purpose of class demonstration, but such slides are very expensive, and require some time to prepare; while chemically colored slides are quickly produced, and cost practically no more than the ordinary kind.

There is one point which is important in producing the very best grade of lantern slide with the Paget plate. This is the clearing operation which must follow the fixing. The development should be carried a trifle further than normal, and after the slide is fixed, but before washing, swab it over with a tuft of cotton immersed in a weak solution of ferricyanide of potassium (red prussiate of potash) of the color of very pale sherry. This will remove all chemical fog and clear up the whole image while reducing the entire deposit a trifle.

Areas too prominent and calculated to divert attention from the greatest points of interest, may be either reduced or entirely wiped out. For instance, in the cross section of the skin, and the tissues below, it frequently happens that the portion outside of the tissue proper shows refraction areas, or specks of dirt, and bits of the tissue. These can be entirely removed by rubbing gently with the cotton dipped in a strong solution of ferricyanide, being careful to hold the slide so that the solution will not run down onto the image of the section.

It is frequently the case in sections through the skin and below, that the epidermis is brought out with too much prominence; while the tissues below are the subject of discussion, and therefore, it is wise to reduce this superficial layer to a density which will not attract the eye away from the main subject.

MAKING THE ENLARGEMENT

A convenient form of enlargement for demonstration in a small class is a circle of about 18 inches in diameter, mounted upon a very heavy square card with a white margin of about an inch on each side. These can be either set up before the class, or handed around. The method of producing these does not differ materially from that usually employed.

I use a rather weak negative, such an one as would give an Aristo print of fine gradations, with no portion very dense.

Parallel light is obtained by means of an arc lamp and a condenser so arranged that the arc is at its focus. Only the central portion of the condenser is used; i. e., we would use an 8-inch condenser to project a negative image of not more than 4 inches in diameter. The finest medium focus, double series, view lens, is used for projection, and it is well stopped down, say to F.-16. A paper made by Eastman, of quick speed for the class of negative employed, is tacked to a board absolutely at right angles to the axis of the beam of projection, and enough time is given to insure the obtaining of every detail of the image.

Where there has been over-staining in certain areas of the sections, portions may be shaded to prevent false effects.

Developing is done in adurol: one portion of developer to about 30 of water, and bromide added according to the character of the image required. After development, wash and place in a weak solution of hypo, with a saturated solution of chrome alum added, say in the proportion of 1 to 20, in order to prevent blistering.

The quantity of chrome alum to be added depends somewhat upon the temperature. A solution of formaldehyde, made very weak, may be used after the print has been partially washed upon removal of the hypo solution. Wash thoroughly and hang up to dry.

Adurol, if properly handled, gives a brownish tone just off a black, and adds life to the enlarged image.

In making the enlargements from a negative with clear glass surrounding the round microscopic image, a piece of dense paper, preferably the yellow post office paper, is cut to whatever size we desire, and placed back of the negative so as to cut off the light of the arc lamp from the surrounding area.

It is well to reduce somewhat the size of the image upon the negative by allowing the paper to lap down upon the image. This gives a clear cut edge to the circle when enlarged upon the bromide paper. The writer believes that if this system is followed out, with such modification as may occur to the manipulator, the result for class demonstrations with lantern slides and enlargements will be superior to that now generally obtained.